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JUNE 15, 1917

AVIATION
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AERONAUTICAL ENGINEERING

VOL. II. NO. 10

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LESTER D GARDNER

Military Editor
1st Lieut. PHILIP J. ROOSEVELT*
*Absent on duty, Aviation Section U. S. A.

AVIATION AND AERONAUTICAL ENGINEERING

Technical Editor
A. KLEMIN A.C.G.I., B.Sc., S.M.
Instructor in Aeronautics
Massachusetts Institute of Technology

Business Manager
GEORGE NEWBOLD

Vol. II June 15, 1917 No. 10

If it were possible to give an account of the happenings of the last two weeks at Washington, it would become evident that at last plans are being considered which will, if carried out put the United States in the war in the air as an important factor.

Conferences have been held with the Army and Navy, the Aircraft Production Board manufacturers of airplanes and possible producers of engines and fittings. The foreign officers have been giving detailed information at these meetings which has expanded the plans of this country to what appears to be a program of at least one hundred thousand airplanes, calling for the immediate expenditure of nearly $600,000,000 with an ultimate budget of a round billion.

But more important than the plans for the future is the decision to furnish immediately airdromes in this country with standardized equipment which by September will enable the camps to produce one thousand aviators a month for our allies.

Already orders have been put under way for the parts and engines of the machines designed for this work and as soon as the present appropriation becomes available larger orders will be given immediately.

If the necessities of this country are to be met Congress must act at once without delay and postponement. The people of the country are aroused to the needs of the air service and will give their support to army appropriations which our allies believe will help win the war.

The Department of Aeronautics

Hearings have been held on the bill to create a new member of the Cabinet to be the head of a Department of Aeronautics. General sentiment seems to be in favor of such a department but whether or not the development for the present cannot be entrusted to the joint action of the Army, Navy and civilian advisers will have to be given careful consideration.

The chart which appears elsewhere in this issue, giving the organization of the air service, will do much to clear up the muddled condition of public information regarding the activities of the various agencies at work on aerial development.

The Aircraft Production Board it should be clearly understood is acting in an advisory capacity only, and derives its authority from the Council of National Defense. It was appointed at the request of the National Advisory Committee for Aeronautics. Howard E. Coffin, who is a member of the Advisory Commission of the Council, was requested to appoint such a board, and the membership was selected by him. It, therefore, as is shown by the chart, acts through the Cabinet members who are members of the Council. Much of the red tape has been cut by the appointment of General Squier and Admiral Taylor on the board. It is understood that the Board is paying its own expenses until an appropriation for its work becomes available.

If an efficient air service is to be built up and civilian advice is to be sought, more authority should be given than the Aircraft Production Board now has and more responsibility required. The reputation of the members of the Board is such that they have secured general public confidence, but the experience of our allies with boards should be given the closest study so that we may profit by their experiences. The general impression seems to be that a department of aeronautics will soon take equal rank with the Army and Navy. If this is true the sooner we start right the better.

The Need for Personnel

The pictures of the Royal Flying Corps Field at Camp Borden, Canada, printed on another page of this issue, must make clear to anyone that there is a serious problem in the training of cadet military aviators aside from that of equipment.

The large number of instructors, mechanics and other personnel needed to train a few cadets is evident, and one of the most immediate of our needs is a plan to secure these recruits for United States Army flying fields. Expert mechanics are hard to secure at present in any industry notwithstanding the high wages offered. The Government will have to make this branch of the service very attractive to this type of recruit to secure them in the numbers needed.

Of the greatest importance is the flying instructor. These exceptional men can only become available through experience and this can only be acquired by time. If the vast number of cadet aviators are to be well trained this serious requirement will have to be considered immediately.

It has been stated that French and English flying instructors would be sent to this country to assist in training our cadet aviators. If this is to be done, a part of the problem will be solved, but to use the thousands of airplanes that are to be produced to the best advantage a special provision must be made for the production of instructors. Otherwise the vast program of production will be clogged at its most vital point.

Materials in Airplane Construction*

By N. L. Liebermann

Specification Engineer, The Curtiss Aeroplane Co.

Linen

A correct determination of the desirable physical properties of linen must be based on an analysis of the linen under load.

The use of linen as a structural material is comparatively new. On this account there exists a great variation in the requirements which this material must satisfy. The researches of the Royal Aircraft Factory have been, for several years, the standards upon which the strength of doped and undoped linen is based. The method has generally been to request samples from several mills, and set as a standard the highest quality obtained. While this method has the advantage of establishing a very high criterion, it simultaneously requires a material far in excess of the needs of the machine. A parallel case would be if it were required to make all steel parts of nickel-chrome steel, because this material demonstrates superior qualities to ordinary carbon steel.

An airplane entering on a nose dive, and descending about 2,000 ft., would be moving about 100 to 150 m.p.h., depending on the size of panels, stream-line adaptations, etc.

If the airplane now be straightened out, so that the panels pass through the critical angle for the wing curve, the maximum possible pressure on the linen will be exerted. For this discussion, an R.A.F. No. 6 curve may be assumed. The critical angle is about 15 deg. For a median section on the panel (where the air pressure distribution is practically constant, parallel to the leading edge), the maximum suction on the upper surface has been found by laboratory experiments to be 2.0pv² (= 2.0 × .00511v² lb./sq. ft., in which v = miles per hour). The following table and curve represent the estimated pressure at 150 m.p.h. on an R.A.F. No. 6 wing curve, at 15 deg. angle of incidence.

TABLE NO. 1

Distance from leading edge	Suction lb. per sq. ft. on upper surface	Pressure lb. per sq. ft. on lower surface
.000	229.50	56.00
.100	166.40	49.20
.200	142.50	36.91
.400	86.00	27.81
.600	31.20	16.75
.800	16.20	10.65
.967	5.74	0.191

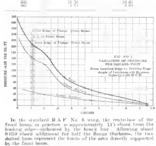


FIG. NO. 1
VARIATION OF PRESSURE PER SQUARE FOOT
From Leading Edge to Trailing Edge
Angle of Incidence = 15 Degrees
Velocity = 150 M. P. H.

In the standard R.A.F. No. 6 wing, the centerline of the front beam, in practice is approximately .115 chord from the leading edge—indicated by the heavy line. Allowing about 0.010 chord additional for half the flange thickness, the two dotted lines represent the limits of the area directly supported by the front beam.

The general type of panel used in current practice is designed with a rigid covering on the upper surface, from the leading edge to the front beam. This is generally a wooden veneer. The area covered by the linen commences at the rear edge of the upper flange of the front beam. The bottom surface is generally completely covered with linen.

Controlling Factors

The tension in the linen is dependent upon several factors, among which may be mentioned, (1) the span or distance between centerline of ribs, (2) the loading, and (3) the initial tension in the linen due to the application and shrinking of the dope.

The first factor is practically constant for any given location in the panel.

The loading is a variable force, depending upon the location in the span of the panel, and generally decreasing from the leading to the trailing edge. This factor attains its maximum value at the critical angle for the given wing curve.

The doping as first applied to the linen, induces an initial stress, as it dries and shrinks on the covering. This is evident from the tautness and slight concave sag noticeable between the ribs of a new panel when viewed in the direction of the chord. The exact amount of this force, however, is dependent upon so many factors, governed by the chemical composition, humidity at time of drying, thickness of application, texture of the linen, etc., that it cannot be stated with any degree of accuracy, even in an empirical formula. Furthermore, due to the general instability of the dope coating, its tendency to sublimate (cellulose nitrate) or crack (cellulose acetate) the initial state of tension is soon reduced, and ultimately lost. The linen however still retains the dope with which it was impregnated, thus remaining practically air-tight. The small tension however, may be considered as having been removed.

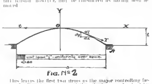


FIG. Nº 2

This leaves the first two items as the major controlling factors. In Fig. 2, it is assumed that the linen under load has stretched sufficiently to form the indicated contour. For the major portion of the panel, the load is applied uniformly (transverse to the axis of the machine).

Assume a unit load p applied uniformly over the span. Since the linen is in equilibrium, it may now be regarded as a rigid member. Furthermore, it is also the line of the equilibrium polygon of all the forces acting on it. The load may be divided into small equal units, each δs long (therefore p = load over "δs" portion of the span). Since the unit load may be assumed to be concentrated at its "center of mass," the point of application of each unit load is δs distance apart.

Let l = length of the linen between supports
- s = span between supports
- h = maximum vertical displacement due to load
- X = sum of the x-components of the external forces between O and 1
- Y = sum of the y-components of the external forces between O and 1
- T = tension of the linen at any point
- t = tension of the linen at the highest point

From the diagram the x component of T at any point $= t_x = T\frac{dx}{dl}$, also the y component of T at any point $= t_y = T\frac{dy}{dl}$.

For the part O 1, the conditions for equilibrium are

$$\Sigma X = O \qquad T\frac{dx}{dl} - t = O \qquad (1)$$

$$\Sigma Y = O \qquad T\frac{dy}{dl} + Y = O \qquad (2)$$

Since $Y = -px$, equation (2) becomes

$$T\frac{dy}{dl} - px = O \qquad (3)$$

From equation (1) and (3), the expression $y = \frac{px^2}{2t}$ is derived. This equation contains three unknowns, x, y, and t. The value of t in terms of the conditions may readily be determined by substituting $x = \frac{s}{2}$ and $y = h$ in the above expression.

The equation of the curve which the linen assumes, when loaded uniformly across the span, may thus be reduced to

$$y = \frac{4hx^2}{s^2} \qquad (4)$$

The form of the equation indicates a parabola depending on the value of h. The tension in the linen at any point is indicated by the formula

$$T = t\frac{dl}{dx} = t\left[1+\left(\frac{dy}{dx}\right)^2\right]^{1/2} \qquad (5)$$

which reduces to

$$T = \frac{ps}{8h}\left[1+\left(\frac{16h^2}{s^2}\right)\right]^{1/2} \text{ at the ends} \qquad (6)$$

$$\text{and } T = \frac{ps}{8h} \text{ at the center of the span} \qquad (7)$$

It thus becomes evident that the stress increases from a minimum value of $\frac{ps^2}{8h}$ at O to a maximum value of $\frac{ps^2}{8h}\left[1+\frac{16h^2}{s^2}\right]^{1/2}$ at the edge of the rib strip.

In both these values, as in the equation of the curve assumed by the linen under load $\left(y = \frac{4hx^2}{s^2}\right)$, the term h or "rise" appears. The rise is a factor depending upon the load, length of the span, and stretch of the linen.

The percentage of stretch of the linen depends on a series of variables. Fig. 3 shows graphically the results of some tests performed by the R.A.F. on undoped linen. The line assumed as representative of the stretch is based on a high grade, close warp and weft linen, with an ultimate strength of about 96 lb.—the stress being applied 45 deg. to both the warp and weft. This assumption allows 8 lb. loading per inch width per percent elongation for each inch of length, or 0.125 per cent elongation per inch for each pound loading per inch width. Using the above notation, the length of the linen under loading will be

$$l = s(1 + .00125T) \qquad (8)$$

If this value be equated to the length of the linen obtained from the curve assumed due to loading, a relation between h and s may be established. The equation of the curve is

$$y = \frac{4hx^2}{s^2}, \text{ from which } dy = \frac{8hx}{s^2}dx$$

substituting $\frac{1}{b} = \frac{8h}{s^2}$ in the above and developing $dl = \sqrt{dx^2 + dy^2}$, we have $dl = \frac{\sqrt{b^2+x^2}}{b}dx = \frac{b\,dx}{\sqrt{b^2+x^2}} + \frac{x^2\,dx}{b\sqrt{b^2+x^2}}$ from which may be determined

$$l = \frac{s}{2}\left[1+\frac{16h^2}{s^2}\right]^{1/2} + \frac{s^2}{8h}\log_e\left[\frac{4h}{s}+\left(1+\frac{16h^2}{s^2}\right)^{1/2}\right] \qquad (9)$$

This gives the exact length of the curve assumed by the linen under load. From equations (8) and (9), the absolute values of h may be determined. A very close approximation and more readily handled formula may be obtained as follows:

$dl = \sqrt{1+\left(\frac{dy}{dx}\right)^2}$ from $y = \frac{4hx^2}{s^2}$, $\frac{dy}{dx} = \frac{8hx}{s^2}$, hence $dl = \sqrt{1+\frac{64h^2x^2}{s^4}}$, hence $l = 2\int_0^{s/2}\left(1+\frac{64h^2x^2}{s^4}\right)^{1/2}dx$

Expanding the term under the radical by the binomial theorem,

$$\left(1+\frac{64h^2x^2}{s^4}\right)^{1/2} = 1 + \frac{32h^2x^2}{s^4} - \frac{512h^4x^4}{s^8}$$

$$\text{from which } l = s\left(1+\frac{8h^2}{3s^2}\right) \qquad (10)$$

Since all values of $\frac{h}{s}$ from $\frac{h^4}{s^4}$ inclusive, and on, are very small and unaffecting on the general result.

Combining the two values of l, $s(1 + .00125T) = s\left(1+\frac{8h^2}{3s^2}\right)$

$$\text{hence} \qquad T = \frac{6400h^2}{3s^2} \qquad (11)$$

The value of T at the top of the stressed linen is $\frac{ps}{8h}$. Hence, if w = the loading over the span, per inch width ($= ps$), and the above value of T be substituted in equation (11), we have

$$h = \frac{s}{8}\sqrt[3]{\frac{3w}{100}}$$

Distortion of Linen

Substituting the value of h thus obtained, in the formulas for the maximum and minimum values of T, we can determine the tension at the center and ends of the span.

As previously mentioned, the upper surface of the panels, from the leading edge to the front beam, is covered with some rigid material, generally wood veneer, with a view of maintaining the proper "entering contour," and also to resist the high tension induced by the suction. Under the conditions above assumed (velocity 150 m.p.h. and the machine straightening out from a nose dive), the upward lift on the front edge would have a maximum value of approximately 298 lb. per sq. ft., or 2.07 lb. per sq. in. If linen were used as the covering, and the distance between the inner edges of the ribs be taken as 15 in., the loading on the linen per inch width in the direction of the chord would be 15 × 2.07 = w = 31.05 lb. The distortion of the linen would be $h = \frac{15}{8}\sqrt[3]{\frac{3 \times 31.05}{100}} = 1.84$ in.

The tension in the linen is then T = 35.2 lb. per linen inch width. While this would allow a factor of safety of 2.72, the longitudinal contour of the panel would be extremely distorted by the "rise" in the span of the linen.

From the curves represented in Fig. 1, the total loading on

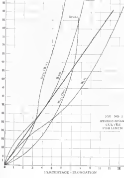


FIG. NO. 3
STRESS-STRAIN CURVES FOR LINEN

the linen at the rear edge of the flange, front beam would be a maximum when the lower surface covering is broken In this case, the loading on the upper surface would be the combined values = 204 lb per sq ft. = 1 415 lb. per sq in , for a width of one inch, measured along the chord Assuming again, 15 in as the distance between the inner edge of cap strips (this allows about 1/8 in. center to center of ribs), the total loading on the strip of linen 1 in. wide equals 15 × 1 415 = 21 22 lb

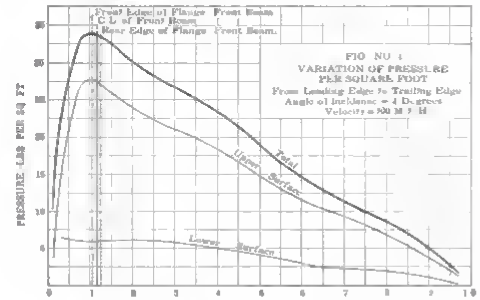
$$\text{The rise, } h = \frac{15}{8}\sqrt[3]{\frac{3 \times 21.22}{100}} = 1.61 \text{ in.}$$

Factors of Safety

The tension in the linen for the above value of h will be 27 lb per inch width. This allows a factor of safety = 3.5/8, on the basis of 96 lb ultimate strength. The above rib spacing assumed is rather high, but, even under these conditions, the linen is safe. With the average spacing of ribs taken as 14 in center to center, or 12 in. clear span, the tension $T = 22.92$ lb. per inch width, which gives 4.2 as a factor of safety.

The above conditions, of course, are extremely severe, and only encountered on comparatively rare occasions. Under normal conditions, the velocity may be assumed at 100 m p h as the critical case. Since the pressure varies as the squere of the velocity, the corresponding values for 100 m p h would be $\frac{100^2}{150^2} \times \frac{204}{T} = \frac{90.78}{T}$ lb. per sq. ft., or 0.63 lb per sq. in , for which $T = 13.50$ lb per inch width ou 12 in clear span, with 7.1 as a factor of safety.

If the machine be flying at some normal angle of incidence, say 4 deg., at 100 m.p.h , the pressure variation would be represented by Fig 4.



By an analysis similar to the preceding, $T = 6.52$ lb per inch width, for 12 in span, and 7.75 lb per inch width for 15 in span, with 14.7 and 12.4 respectively as a factor of safety

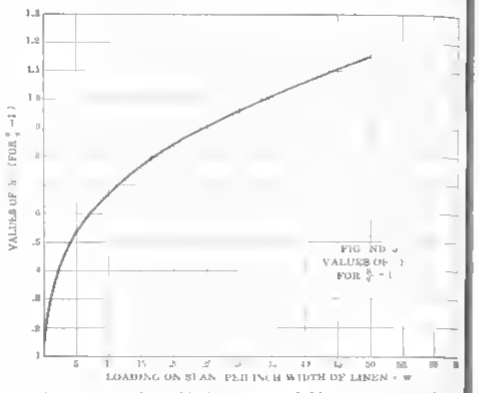
In Fig. 5, the values of h have been plotted, for various loads on the span, of unit width (1 in.), with the factor $\frac{x}{8} = 1$

This, of course, is the same as the deflections on an 8 in span For any other width of span, the deflection is the value of h corresponding to the loading, multiplied by the factor $\frac{x}{8}$.

The entire foregoing discussion clearly shows that the linen requirements demanded by present practice are very high Only under rare occasions does the tension rise over 25 lb per inch width. A factor of safety = 5, with the average loading 15 lb per inch width, would require a linen of 75 lb. per inch width ultimate strength This value would permit the use of many fabrics which to-day are excluded by the high physical values demanded, and prevent the rejection of otherwise good and readily procurable linens

Dope

There is no doubt that the ideal dope should be a cellulose ester. The particular choice between a nitrate or an acetate, or a combination of the two, or even some other formula, is a matter which has not yet been fully determined by laboratory research. One of the difficulties in arriving at a suitable base in making dopes is the inability of selecting a coevaniant solvent The physical and chemical analysis given for the rapid breaking down of dope is the too rapid evaporation of the liquid of solution, or sublimation of the solids of solution.



Further, certain desirable bases are soluble in certain values only The German "Celile," for example, is more readily soluble in acetone, whereas the cellulose nitrate is used generally with amylacetate

Tetrachlorethane has the decidedly advantageous property of rendering a dried cellulose acetate solution very pliable and elastic, but the normal disadvantage in the use of this compound is the poisonous fumes given off in the handling When the percentage of tetrachlorethane falls below ten, the advantages are not in proportion to the danger involved in the use of this combination This, at least, is the present status in formulating dope One of the fields in which researches are being made is the possibility that, perhaps, with a new solvent it will be possible to get a pliable dope, or, at least, one which will not evaporate as rapidly as the present compounds.

Disadvantages of Nitrates

The disadvantages of the nitrates are

(1) The rapid evaporation of the solvent, alternately leaving little or no cellulose coating on the fabric.
(2) The inflammability of the coating, either wet dry, or in fumes.
(3) Its unstable equilibrium in sunlight.

A probable explanation for the degrees in the thickness of the coating is that due to the evaporation of the solvent the cellulose nitrate will first shrink in the thickness dimension. When the surface tension has reached a certain point, the internal rearrangement under the surface skin causes a readjustment so that the planer dimensions are affected. This is the phenomenon known as shrinkage. From this stage on there is a gradual diminution in the thickness, progressing at a faster rate than the corresponding change in the planer dimensions.

There is undoubtedly a certain definite relation between the rays of the sun and the decomposition of cellulose nitrate dope for this compound, when subjected to artificial heat of ever greater range of temperature than that derivable from sunlight, does not show as great a diminution in volume, nor the breaking down of the radicals Furthermore, given the same temperature of sun heat but in two different lights, the action of the dope is different That is to say, the actinic portion of the sun's rays are the destructive agents Investigations in this direction can be very properly made with the aid of a spectroscope. While no results have as yet been published, as any definite experiments been made with this instrument, the analysis and method of attack would be very similar to that used in analyzing other compounds that are effected by the sun's light.

A film made of either an acetyl- or a nitro-cellulose compound, subjected to spectroscope analysis, should individually give their distinctive spectra If these be examined for different periods of time of exposure to the sun's rays, it may be expected that certain lines will be accentuated, due to some internal rearrangement of the radicals. The co relation between these lines and the decomposition of the dope would then offer a clue to further lines of study

Cellulose acetate is affected by the action of the sun's rays in a different manner from that of the nitrate The nitrate shows definite signs of evaporation. The solvents, while not evaporating as rapidly, dry ont and leave a body to the deposit. This deposit is characterized by excessive brittleness, and, if physically disturbed, develops concentric cracks These cracks are sharply defined, and would seem to indicate a high degree of surface tension

Cause of Streaks

Streaks are the results of unequal evaporation in the body of the deposit This is most probably due to the method of application with brushes. The brushes leave slight ridges or "hills and dales" It naturally takes longer for the ridges to dry than it does for the hollows The percentage of amylacetate which evaporates from the thinner coating of cellulose nitrate dopes is greater than that from the heavier portion This causes a condition of non-equilibrium between the two adjacent portions of the coating. The cotton is then precipitated in the thinner parts, due to this condition of unstable equilibrium, causing the well-defined streaks. This action is accentuated if the doping is done on humid or damp days.

A determination of any one physical constant for dopes does not necessarily give a clue as to its desirability In cellulose nitrate, the specific gravity may be kept constant, while the percentage of solvent and of cotton may be varied. The viscosity number, at a given temperature, depends upon the age of the dope and its condition of exposure to the atmosphere With the highly volatile solvents, a drum exposed for 24 hours may show an extremely high viscosity. The same general remarks are applicable to the temperature of the flash-point However, by a careful control of the three factors, a uniform and satisfactory dope may be evolved.

In conjunction with the above constants, the dope should show distinct adhering and penetrating qualities when applied to fabrics. comparative solubility of "dried" dope in liquid dope, and reasonable resistance, when dry, to the action of the elements

Airplane Engine Power Rating

By H. E. Morton

Aeronautical Engineer, B F Sturtevant Co.

Not only in the airplane engine industry but also among the automobile and motor boat engine builders there has always seemed to be about as many different methods of power rating as there are manufacturers Referred to the actual possibilities in service some ratings are too high and some too low

There should be some definite process by which the rating of an engine for each class of service may be arrived at There can be little doubt as to the impracticability of rating an engine at the maximum obtainable from it when tuned up to the utmost and under ideal conditions. It is just as unsatisfactory to fix a rating which is decidedly lower than what is obtainable under ordinary conditions The allowance in either direction should be uniform for all engines intended for any particular service

The gasoline engine of the constant volume type, in direct contrast with the electric motor or steam engine has no overload capacity at a fixed speed excepting a comparatively small amount, resulting from an over rich mixture Therefore an airplane engine cannot be overloaded so far as power developed is concerned. The term "overloaded" is often times misused in this connection to mean an overstressed engine However, an overstressed engine is an overloaded plane might be loosely considered an overloaded engine, but in reality is either an over rated engine or an engine operated considerably in excess of its safe rating

The airplane engine when under load is practically a fixed speed engine, due to the fact that the power absorbed by a propeller increases as the cube of the speed, while the power developed increases as the first power or less. Properly rated, such an engine has no real overload capacity but must be designed to operate continuously at its rated power. Here is an important difference between an airplane and an automobile engine

The automobile engine is anything but a fixed speed engine and through the transmission can be operated at speeds limited only by the driver's intelligence or the wrecking and stalling speeds of the engine. There can be no rated speed although the normal speed will usually be that corresponding to a car speed of thirty miles per hour But at this speed the engine is throttled Probably the most severe service speed test with any duration on an automobile engine is imposed when the car is driven on a smooth, level track at the speed where the engine power at full throttle just equals the power absorbed by the car. Here much the same as in the case of the airplane, with increasing speed the power absorbed increases much more rapidly than the power developed Due to the possibility of much higher engine speed through the transmission there is some justification in rating an automobile engine at the peak of the power speed curve

Considering the airplane engine alone, the rated power may properly be allowed to fall below the maximum by a few per cent only as it is an accepted practice to spend the necessary time on the engines to keep them reasonably well tuned up With a fully developed engine such tuning up does not require a great amount of time by a good mechanic

Before proceeding further it is necessary to understand what is intended by maximum power This involves al once the "rated speed" because power output means nothing unless it is obtained at a usable rotative speed of the propeller Maximum power at rated speed is what we have to consider but the rated speed should certainly not exceed 85 per cent of the speed at which the power no longer increases with the speed.

If an engine is designed to mount the propeller directly on the crankshaft, we have another speed limiting feature. There is good reason to believe that wooden propellers will not give undue trouble if in the air the speed does not exceed 1200 r.p.m. but this is not always sufficient speed to show a good engine weight per horsepower Metal propellers may partially solve the problem The use of better wood or some composite material may allow the speed to be raised slightly

It is impracticable to reduce the propeller speed so far as would be done if the only object were to increase efficiency because the diameter of the propeller increases beyond a desirable limit. Obviously with small powers the propeller speed may be cut away down but with the larger engines ground clearance must be maintained and at the best four bladed propellers may be required Gearing down the propeller allows its speed to be determined apon without necessarily affecting the crankshaft speed and the gearing loss may be made exceedingly slight.

Furthermore, should we not take advantage of the possible increase of power with speed up to a certain point? It is usually true that the average well designed airplane engine intended for operation somewhere between 1200 and 1400 r.p.m. may be operated with increasing power up to 1800 r.p.m. without overloading bearings or getting into any incurable difficulties. But such a speed is not practical unless the propeller is geared down. Nevertheless, a direct drive airplane engine is brought out now and then with four valves per cylinder, a complication which is hardly worth while under 2500 r.p.m

There is a question as to whether engine rating should be based on the maximum power with an overrich mixture or on that developed with highest efficiency On the whole, it would seem best to take the power obtainable with a thirty inch barometer and with a mixture midway between the maximum power and minimum consumption points. It is to be remembered that with increasing altitude or dropping barometer the mixture becomes richer, hence the mean value of both barometer and richness is desirable.

As a summary suggestion why not consider the rating of airplane engines as follows: Ninety-five per cent of the average maximum power of three well tuned production engines with thirty-inch barometer, mean mixture adjustment as described above and at a definite practical propeller speed such as 1200 r.p.m.?

THE FLYING MACHINE FROM AN ENGINEERING STANDPOINT

By F W Lanchester D Van Nostrand

This Mr Lanchester's latest volume, is a reprint of the James Forrest Lecture for 1914, with the addition of a discussion concerning the theory of sustentation and the expenditure of power in flight, the latter having been presented to the International Engineering Congress in San Francisco in 1915 The range of territory covered is enormous, and the treatment of each topic is necessarily a little brief, the author aiming to give an outline of his own original conceptions and theories, rather than to cover the whole field, or any part of it, very completely

The chapters on catastrophic instability and stability and control, too, are worthy of special mention

Course in Aerodynamics and Airplane Design

By Alexander Klemin, A.C.G.I., B.Sc., S.M.

Instructor in Aeronautics Massachusetts Institute of Technology, Member of the Aeronautical Society of Great Britain and Ireland,

and

T. H. Huff, S.B.

Instructor in Aeronautics, Massachusetts Institute of Technology

PART II—SECTION 9

Type Sketches of Secondary Training Machine—General Principles of Body Design

In Fig. 1 are shown three views of a secondary training machine, very similar to the JN-2, and in accordance with our figures of *Section 7*.

A few modifications have been made in the process of drawing up the machine from the figures given in *Section 7*. The figures there were derived from empirical formulas, but in the present stage of the art it cannot be too strongly insisted that no empirical formulas hold with absolute rigidity, and that "eyeability" is almost as important—except in the case of the stabilizer and elevator, on which more data is available. Thus the rudder has been reduced in area from 12 to 10 sq. ft., and the vertical fin from 4 to 3.5 sq. ft.

The stabilizer and elevator have been left unchanged. In drawing the plan view of the machine, modifications were also found necessary in the ailerons. The original scheme was to place the ailerons on the top plane only. But in order to secure the necessary area it was necessary, with the spar position selected, to make the ailerons very long and bring them in comparatively close to the body (with an overhang on the top plane this difficulty would not have occurred), and ailerons brought in close to the body have an insufficient lateral range for part of their surface. The better plan seemed to be, therefore, to place the ailerons on both surfaces. Their area was also slightly increased, from 38 to 42 sq. ft. total area.

It must be insisted upon again that this machine is not a perfect specimen of its type. For instance, had an overhang been employed as on the JN-4, the aileron area of 35 sq. ft., with its greater lever arm, would have been amply sufficient. Also the outer strut would have been almost at the mid point of the aileron, thus permitting the use of a single aileron post, whereas in the present case we are obliged to use two aileron posts.

Another poor point is that the tail skid abuts directly on the rudder post. The control surfaces should never be so placed as to sustain injury by an abrupt landing, as might be the case in this arrangement.

A drag wire is shown carried from the top of the inner strut to the engine. This helps to keep the body from twisting under the effect of gyroscopic forces on the engine, and also to relieve the drag bracing. Nevertheless, in computing the drag bracing the effects of such a wire are totally neglected.

General Requirements in Body Design

These may be very briefly summarized.

(1) Streamline Form

The power plant and personnel must be enclosed in a form approximately stream-lined. The general shape of the body is largely determined by the size and shape of the engine selected. For the vertical six-cylinder engine the body may be narrow and deep. For a V cylinder engine, a wider but shallower body is advisable, and with a rotary engine a body of very large maximum diameter. But consistent with structural and other considerations, a body should be selected which gives minimum aerodynamic resistance. The best form of body would of course, be symmetrical about an axis. Some data for the resistance of airplane bodies has been given in the first part of the Course, but there is no doubt that considerable improvement is possible in this direction, possibly by employment of monocoque construction. Where a four girder body is used, and attempts are made to secure streamline form, the designer must guard against excess weight.

(2) Fin Area of Body

A flat bottomed body may be very helpful in securing longitudinal dynamic stability. A body with flat sides has to be handled carefully. It is equivalent to a long fin, with most of the fin area aft of the center of gravity, and thus tends to head a machine into the wind—an advantage if the effect is not excessive. Such fin area is, however, best secured by the use of a vertical fixed fin. With a large flat sided body it is as well to investigate yawing moments in the wind tunnel. One of the reasons why totally enclosed bodies have not come into use is that with their large fin areas, they have a tendency to spinning.

(3) Length of Body

Apart from the necessary length of body to give sufficient arm to the tail surfaces, it is important that the tail surface should be far enough away from the wing so that the wash of the wings should not affect them too much.

(4) Provision for Pilot and Passenger

The necessary requirements are obvious. To protect the face of the passenger, a transparent hip is generally fitted on the front edge to deflect the air upwards. The back of the pilot's head may be stream-lined with a suitable projection. Specification 1002 gives standard arrangements for pilot's and passenger's seats.

(5) Engine Installation

Should be readily accessible and cowling easily removable.

(6) Gasoline Tanks

Should be near the center of gravity of the whole machine, so as to disturb balance as little as possible as fuel is consumed. Where it is impossible to place the fuel supply directly over the center of gravity, the gasoline and oil may be made to balance one another approximately.

(7) Engine Foundation

Must be rugged to prevent loosening up of the bolts by vibration, transmission of the torque of the engine to the body, and breaking loose in a bad landing. Nevertheless, the foundation should be flexible enough so that slight engine vibration is easily taken up. The following example will illustrate the forces on the foundation bolts due to engine torque. Six cylinder 120 h.p. 1200 r.p.m. Torque $= \frac{120 \times 550}{2\pi \times 20} = 525$ lbs. at 1 ft. radius, or either side. $2k \times .375 = 525$; where .375 is half the distance between engine bed bolts, and the force on either side is 417 lb.

(8) Engine Must Be Secured Against Weaving

When the airplane pitches, there is a tendency owing to gyroscopic action of the propeller, for the engine to "weave" either to right or left. Diagonal members in the plane of the engine bearers as well as wires are often used. The ideal engine foundation would seem to be of pyramidal form.

(9) Strength of Body

The body must be strong enough to withstand (a) air loads due to tail surfaces, (b) dynamic loads in the air, (c) loads on landing.

These are but a few of the requirements in body design. Numberless points arise in detail work, in which experience and rare, and not general rules, are necessary.

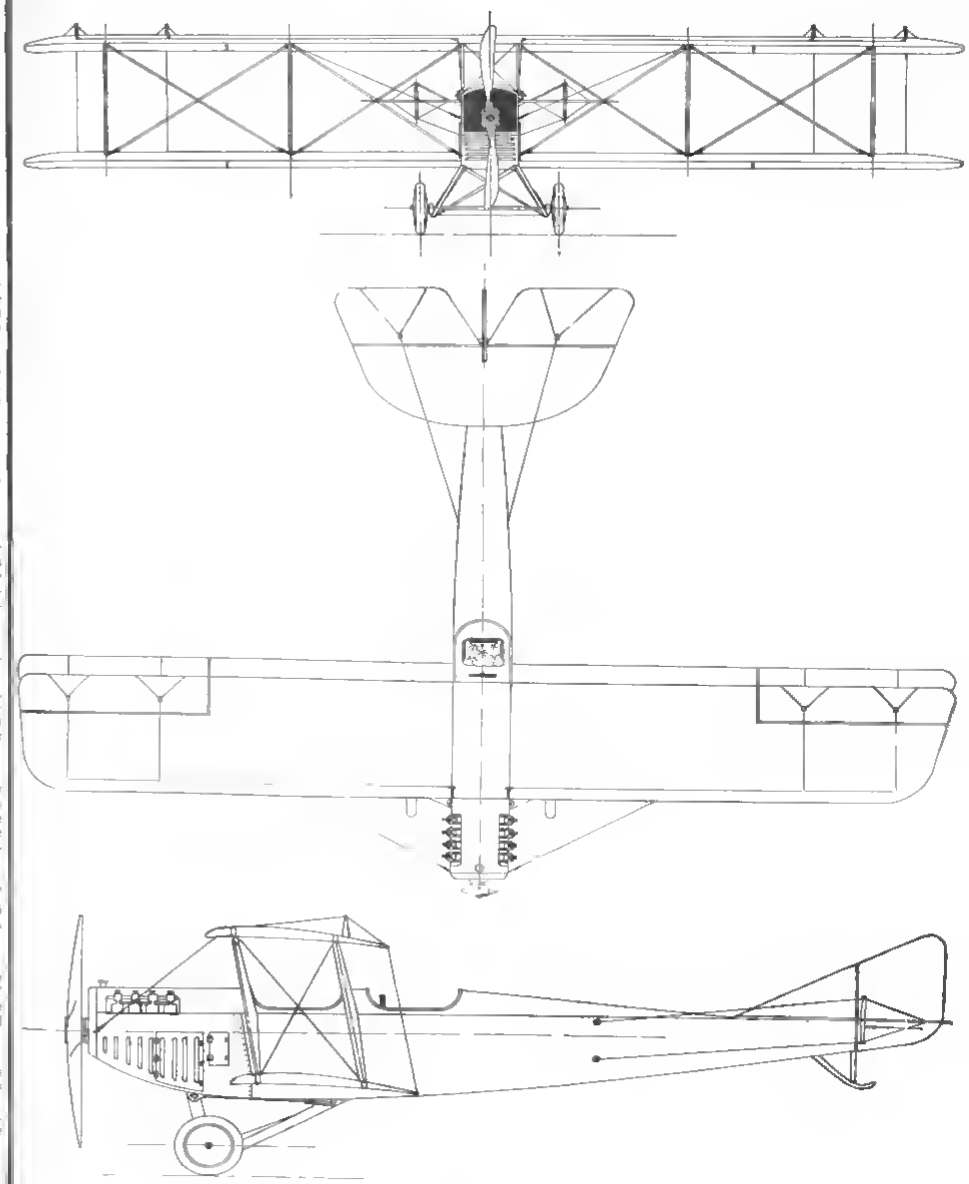


Fig. 1

Formulas for Spruce Compression Members

The most reliable data on spruce struts—the material in which we are most interested—is given in Dr. Hunsaker's note to which reference is appended Experiments were carried out on Maine white spruce, West Virginia white spruce, and Oregon red spruce Values varied so much for each specimen that it would be unsafe to use them definitely for wood of varied origin, of varied position in the log, and degree of seasoning, and in actual construction tests on specimens are always necessary

In these experiments, the modulus of elasticity found by observing deflection under loading was found to be 1,825,000 pounds per square inch. Two formulas for crippling stress, defined as the crippling load divided by the area of cross section in square inches, were deduced

(1) For long struts $\frac{L}{K} > 70$ $\frac{P}{A} = \frac{8.72\,E}{\left(\frac{L}{K}\right)^2}$ where P = crippling load A = area in square inches L = length in inches K = least radius of gyration in inches E = modulus of elasticity in pounds per square inch (Some designers employ the ordinary Euler's formula, $\frac{P}{A} = \frac{\pi^2 E}{\left(\frac{K}{L}\right)^2}$ using a value of E = 1,600,000.)

(2) For short struts $\frac{L}{K} < 70$ $\frac{P}{A} = 6500 - 46.5\frac{L}{K}$ (Some designers employ a modification of Rankine's formula: $P = \frac{A\,fc}{1+\phi}\left(\frac{L}{K}\right)^2$ where fc = 8,000 lbs for spruce, E = 1,600,000, $\phi = \frac{fc}{\pi^2 E}$)

By careful selection of spruce the crippling loads given by the above formulas can be easily secured. It was formerly customary to use a material factor of safety of 2 for the wing struts, and 1½ for body struts

There arises a further difficulty in connection with the above formulas, in determining whether a strut is fixed or hinged at the ends It is usually assumed that

(1) wing struts with pin joint fastenings are hinged at either end.
(2) wing struts with socket fastenings of usual type are considered as being fixed at one end, and round at the other
(3) body longitudinals, continuous over joints are taken as fixed at ends
(4) body horizontal and upright struts are taken as fixed at one end and hinged at the other

For a strut fixed at one end, and hinged at the other, the equivalent length becomes $\frac{L}{\sqrt{2}}$, for a strut fixed at both ends, the equivalent length becomes $\frac{L}{2}$ Thus the above formulas become:

(1) Ends hinged $\frac{P}{A} = \frac{8.72\,E}{\left(\frac{L}{K}\right)^2}$ $\frac{P}{A} = 6500 - 46.5\frac{L}{K}$

(2) One end fixed one hinged $\frac{P}{A} = \frac{8.72\,E}{\frac{1}{2}\left(\frac{L}{K}\right)^2}$ $\frac{P}{A} = 6500 - \frac{46.5\,L}{\sqrt{2}K}$

(3) Both ends fixed $\frac{P}{A} = \frac{8.72\,E}{\frac{1}{4}\left(\frac{L}{K}\right)^2}$ $\frac{P}{A} = 6500 - \frac{46.5\,L}{2\,K}$

Body Stress Diagrams

Body stress diagrams are still on a somewhat unsatisfactory basis, and a number of different methods are adopted Although the longerons of a body are continuous, and the cross bracing members more or less fixed, stress diagrams are always drawn as if it were entirely a pin-jointed structure Subsequently, compression members are treated as either wholly or partly fixed at the ends This is inconsistent but probably all that can be done, without very lengthy refinements

Factors of safety have been specified in a number of ways, of which we have noted some already

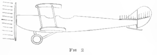


Fig 2

Army Specifications 1000, 1001 and 1002

Air speed, 100 miles an hour. Angles of incidence of fixed horizontal tail surface, minus 6 deg ; elevator surface, minus 20 deg Factor of safety not less than 2.5. This is based on the forces met with when the machine is violently righted after a rapid dive. It takes care solely of the air loads due to tail surfaces When in the air the body is supported at the hinges of the wings, and the air loads are not transmitted to the part of the body forward of the hinge pins It can be seen that this is by no means an ideal specification It has also been criticized on the ground that no pilot can, under ordinary conditions, exert sufficient force to move the elevator to such a position

Army Specification 1003

Body forward of the cockpit shall be designed for a factor of safety of ten (10) over static loading conditions with the propeller axis horizontal Body in the rear of cockpit shall be designed to fail under loads not less than those imposed under the following conditions

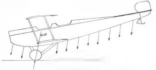


Fig 3

(a) Dynamic loading of 5 as the result of quick turns in pulling out of a dive, (b) superposed on the above dynamic loading shall be the load which it is possible to impose upon the elevators, computed by the following formulas L = 005.1 I V^2 where I is the total area of the stabilizing surfaces, i.e. elevators and fixed horizontal surface, and V is the horizontal high speed of the airplane The units are kilograms, square meters, kilometers per hour, (c) superposed on this loading shall be the force in the control cables producing compression in the longerons

This specification is sounder than the previous one. It imposes the air load on the rear part of the body, which is as it should be, and provides a sufficient dynamic loading for the forward part of the machine

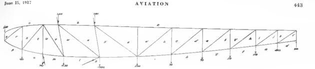
Another Suggested Method

In the author's opinion, the stress diagrams should be even more complete They should include calculations (a) carried through on the air loads, (b) calculations carried through on the landing loads, specifying some landing speed, a gliding angle, and travel of shock absorber

A Detailed Example of Stress Diagram

In Fig 2, is shown the skeleton framework of a JN-4 body which fits in with our design of a standard airplane body In accordance with the preceding paragraph, we should draw two diagrams for it:

(1) With the body and tail surfaces in position shown in Fig 2, horizontal tail surface at minus 6 deg, elevator surface at minus 20 deg The air loads on these surfaces can be computed as follows: Lacking precise experimental data, we may assume that in the worst possible case, the pressure on the tail = .0026 AV^2 area of stabilizer and elevator = 50 sq ft. V, the highest speed attainable during a dive, may be taken as 100 m.p.h P the tail load, then equals .0026 × 50 × $(100)^2$ = 1300 lb



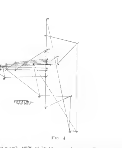


Fig 4

With these air loads computed, a stress diagram can be easily drawn as for a simple cantilever with supports at the rear body hinges As an article in AVIATION AND AERONAUTICAL ENGINEERING for March 1 1917 shows the stresses obtained in this way are in certain members smaller in other members larger than those obtained from the landing diagram

(2) The stress diagram on the assumption of the landing shock leaves room for much discussion The difficulty arises primarily from the fact that it is difficult to say what the worst landing conditions before breaking are for which a machine should be designed Also it is extremely difficult to include all the forces in play, which may include (a) lift on the wings (b) drag on wings and body, (c) lift and drag on the tail surfaces, (d) the reaction perpendicular to the ground (e) tractive resistance on the wheels

Further difficulties arise from the fact that the center of the wheels does not lie under the center of gravity of the whole machine, so that if a dynamic load is applied vertically at the wheels, the weight applied at the center of gravity gives a turning moment which must be balanced in some way or another Two methods are suggested which seem fairly reasonable, and provide a rational method of computation In the first method, it is assumed that the machine is gliding on a path of say 1 in 7, and hits the ground nose heavy In such a case as can be seen from Fig 3 the reaction of the ground may be assumed to pass through the center of gravity of the machine, and a balance of forces is obtained The dynamic load in such a case may be obtained on lines indicated in a previous section on chassis design

In the second method the pilot is assumed to flatten out from the glide, and then turn up to a big angle and pancake down, with the wheels and skid striking the ground simultaneously In such a case, it is very difficult to compute the dynamic load, but a balanced system of forces is readily obtained, distributing the load between the wheels and the skids as shown in Fig 4 The dynamic load factor there is taken as 8 In Table 1 are tabulated the stresses in various members. In the ensuing sections, dimensions will be allotted to such members.

TABLE I

BODY STRESSES

ag	0
aa	460 T
ax	430 C
bx	1680 C
ca	2070 C
ca'	2070 C
cc'	1990 C
ce	1910 C
cg'	1770 C
ci	1540 C
ck'	1170 C
pg	580 C
rs	330 C
tu	3900 C
vw	1410 C
ay	470 C
m'	0
gr	570 T
st	1200 T
uv	3400 T
wx	1910 T
yz	580 T
n'b'	100 T

Longerons	
pr	480 C
ol	1250 C
mn	260 C
lw	1300 T
jl	1600 T
ih'	2000 T
hd'	1920 T
gf'	1780 T
fh'	1560 T
ej'	1180 T
dl'	0
Struts	
b c'	70 C
d e'	90 C
f g'	140 C
h i'	210 C
j'k	310 C
l e	910 C
Wires	
c d	130 T
e f	210 T
g h	300 T
i j	480 T
k'l	1470 T

References, Part 2, Section 9

"Notes sur la Construction des Aéroplanes," by P James, *Revue Generale de l'Aeronautique Militaire* March 1914
"Spruce Aeroplane struts under Compression" by J C Hunsaker *Aerial Age* August 16 1916.

Revised Strength Figures for Wires and Cables

The following revised figures for wires and cables have been issued by John A Roebling's Sons Co., and will supplement the table given in *Part 2, Section 5* of the Course-

Roebling [illegible] Aircraft Wire

American gauge (B&S) Number	Diameter in.	Minimum breaking strength, lb	Weight lb per 100 ft
8	128	3000	4 40
9	114	2500	3 50
10	102	2000	2 77
11	091	1620	2 21
12	081	1300	1 744
13	072	1040	1 383
14	064	830	1 097
15	057	660	870
16	051	540	690
17	045	425	547
18	040	340	434
19	036	280	344
20	032	225	273
21	028	175	216

Roebling 19-Wire Galvanized Aircraft Strand

Diameter of strand in.	Breaking strength of strand lb	Approximate weight lb per 100 ft
5/16	12,500	20 65
1/4	8,000	13 50
7/32	6,100	10 00
3/16	4,600	7 70
5/32	3,200	5 20
1/8	2,100	3 30
7/64	1 600	2 60
3/32	1 100	1 [illegible]
5/64	780	1 31
1/16	500	78
1/32 7 wire	185	[illegible]

Roebling 6 x 7 (Cotton Center) Galvanized Aircraft Cord

Diameter of cord in.	Breaking strength of cord lb	Approximate weight lb per 100 ft
5/16	7 900	[illegible] 00
1/4	5,000	9 30
7/32	4,000	7 41
3/16	2 750	5 30
5/32	2,200	4 20
1/8	1 150	3 20
7/64	830	1 [illegible]
3/32	780	1 30
5/64	480	85
1/16	400	71

Roebling 7 x 7 (Wire Center) Galvanized Aircraft Cord

Diameter of cord, in.	Breaking strength of cord lb	Approximate weight lb per 100 ft
5/16	9,200	16 70
1/4	5,800	10 50
7/32	4 600	8 90
3/16	3,[illegible]00	5 80
5/32	2 600	4 67
1/8	1,350	2 45
7/64	970	1 73
3/32	920	1 41
5/64	530	93
1/16	485	81

Roebling 7 x 19 Tiller Aircraft Cord

Diameter of cord in.	Breaking strength of cord lb	Approximate weight lb per 100 ft
3/8	14,400	26 45
11/32	12,500	22 [illegible]
5/16	9,800	17 [illegible]
9/32	8,000	14 56
1/4	7 000	12 00
7/32	5,800	9 50
3/16	4 200	6 47
5/32	2,800	4 44
1/8	2,000	2 88

Statoscopes

One of the most useful instruments in ballooning and during flight work is the statoscope employed to indicate very slight variations of altitude It may be interesting to set forth the principles of operation of two standard forms in common use

One made by Gradenwitz in Germany is described in Hildebrandt's "Airships, Past and Present" "It is contained in a metal case somewhat similar to that of a watch Being the face is a circular opening, into which a tightly stretched rubber membrane is fitted, and a small rubber tube communicates with the inside of the case If now the rubber tube is pinched, the outer air can no longer freely reach the inside of the case Supposing a balloon or airplane to be ascending the air enclosed within the statoscope will therefore, expand in consequence of the reduced external pressure, if it is descending the opposite effect will take place The contraction or expansion of the enclosed air reacts on the rubber membrane, which will be sucked inwards during a descent, and blown outwards if the balloon is rising The movements of the membrane are communicated by very delicate wheelwork to a pointer on the face of the case, which, therefore, shows at a glance whether a rising or falling movement is in progress."

The Gradenwitz instrument is very sensitive, and much better as an indicator of rising or falling motion than the sluggish barometer It has the disadvantage of requiring some little attention to get a reading the pinching of the tube as mentioned above

The Custer statoscope, according to a pamphlet supplied by the manufacturer, obviates this disadvantage and is sensitive within a few inches vertical motion

The instrument in its simplest form is a glass capillary tube attached to an enclosed reservoir at one end and opening to the atmosphere at the other end A drop of oil in the tube seals the air within the reservoir Any extremely small variation in the external atmospheric pressure will immediately be indicated by a motion of the oil one way or the other in trying to equalize the pressure within the reservoir and without It can easily be seen that by elevating the instrument the atmospheric pressure now being reduced outside the reservoir in comparison with that within, the bubble will move toward the open end of the tube This motion of the oil is so sensitive to slight changes of atmospheric pressure that the motion can easily be detected by the naked eye of a change of vertical elevation of one inch of the instrument Due to this extreme sensitiveness, it will be seen that any great elevation of the instrument will result in the bubble reaching the end of the tube very quickly. To overcome this, the tube is enlarged at each end, and the bubble breaks and forms over again, making the operation continuous

To make the instrument "fool proof," a trap is included at each end of the tube, so that the oil will not escape in any position in which the instrument might be held The entire instrument is enclosed inside of non conducting material so that sudden temperature changes will not materially affect the reading

Aeronautical Patents

Copies of these patents may be obtained for five cents each by addressing the Commissioner of Patents, Washington D C

ISSUED MAY 22 1917

1,227 319 Filed March 20, 1917 To Leon I Hobbins Leadland, Col Toy Airplane.

1,227 344 Filed Feb 21 1917 To Kejo P Togstad Maddock N D Safety parachute for aviators

1,227 464 Filed April 11, 1913 To Ira Emmett McCabe Lexington Neb Aeronautics.

ISSUED MAY 29, 1917

1 226,261 Filed Sept 22, 1915 To Clarence Barritt, Salt Lake City Utah, assignor by direct and mesne assignments, of one-third to George Morrow and one-third to Robert W Salisbury Salt Lake City Utah Aerial torpedo

1,228 331 Filed June 7, 1913 To Glenn H Curtiss, Buffalo, N Y assignor to The Curtiss Motor Company, Hammondsport N Y a corporation of New York. Hydro-Aero machine.

1,228 150 Filed Dec. 24, 1915. To Israel I. Zipersiein New York and Abraham C. Kaplan, Brooklyn, N Y, assignors of fifteen one hundredths to Nathan Schreiber fifteen one-hundredths to Aaron Schreiber, fifteen one-hundredths to Benjamin Kaiser, and five one-hundredths to Benjamin Oppenheim New York N Y, and one thirty-second to Kate Zucker, Chicago Ill Airship.

1 227 912 Filed Nov 17 1916 To Martin Jelalian, Cranston R I Combined dirigible and hydro aeroplane

1 2-7 917 Filed March 31 1916 To Adolf Frank Russ, Pittsburgh Pa Airplane.

1 228,383 Filed July 14, 1915. To Glenn H Curtiss, Buffalo N Y, assignor to The Curtiss Motor Co, Hammondsport N Y a corporation of New York Flying machine

1 228,054 Filed Aug 12 1914 To Charles Lemuel Sanford, Washington Pa assignor to Sanford Manufacturing Co Washington, Pa Flying machine

1 228,227 Filed Dec 18 1916 To Alex Melniczak, Camden N J Airplane

1 228 380 Filed Feb 18, 1914 To Glenn H Curtiss Hammondsport, N Y assignor to The Curtiss Motor Co Hammondsport N Y a corporation of New York Method and system for operating rudders of aircraft

1 228 717 Filed Sept 18 1915 To John P Tarbox and Henry Kleckler Buffalo, N Y assignor to Curtiss Airplane & Motor Corporation a corporation of New York Universal wing post socket

ISSUED JUNE 5 1917

1 228 390 Filed Feb 1 1916 To Louis Béchereau Paris, France assignor to The Society Spad Société Anonyme pour l'Aviation et ses Dérivés. Airplane

1,228,705 Filed March 6 1911 To Osam Shadow, San Francisco, Cal Airplane

1,228,728 Filed Sept 12 1916 To William Frances Williams Lockwood, Mo Airplane

1,229 114 Filed June 2, 1916. To Frederick A Meng and Lee G Schrader, Flint Mich Flying machine

Observations on Physical Effects of Flying

By Dr. Harry L. Schurmeier

The year and a half during which I was constantly associated with flying at the aerodrome at North Island, San Diego, California gave me ample opportunity to observe the physical status of the fliers Two things must be discounted in considering this matter, first the equable climate of San Diego and second, the excellent physical and nervous stamina of the men Regarding the former, San Diego presents practically the same climate as southern Italy, in consequence the diseases of more rigorous climates are rarely seen there.

The men are chosen from the Army at large, practically every corps being represented with the exception of the Medical Corps. The applicants are subjected to a most strenuous physical examination in which not only the general physical and nervous system is considered but also the temperament. Men showing marked nervous tendencies are frequently turned down. Special attention is given to the vision and to the organs of equilibrium as any defect in the latter would obviously unfit a man for service

So it may readily be seen that men subjected to so careful a selective process and living in such an equable climate would have fewer physical ailments than aviators in general From my observations, I came to the conclusion that the effects of flying on the individual are evidenced chiefly on the nervous system and on the general health indirectly through the nervous system

One of the main barometrics of fluctuations in the status of a healthy individual nervous tone, is the blood pressure The blood pressure as studied clinically is represented by millimeters of mercury contained in a glass tube The pressure is taken by placing a cuff around the upper arm and inflating it with air until the pulse below the cuff is no longer perceptible This point indicates the amount of pressure which it takes to obliterate the pulse and equals the pressure in the artery The inflated cuff is connected with the mercury tube upon which the readings are registered

Fluctuations in the pressure are attributed partially to the amount of adrenalin secreted in the blood This substance is elaborated by two small glands lying just above the kidney Variations in the emotions give rise to variations in the secretion of adrenalin and consequent changes in the pressure For instance, fear excessive fatigue, or increased nervous tension, all tend to raise blood pressure

BLOOD PRESSURE EXPERIMENTS

The blood pressure experiments were carried out as follows Certain men some twenty in all, were selected and their blood pressures taken daily, immediately before and after each flight The experiments were carried out over a period of six weeks It was not found feasible to make these observations in the air on account of the noise and vibrations of the machines. As a result of these experiments it was found that the mean general average of blood pressure compared very favorably with the normal for that age.

It was the comparative readings before and after flight which were of interest These readings were shown to be definitely higher in nearly every case immediately before flying The few exceptions to this rule were in men showing marked nervous fatigue or to whom some disagreeable incident had occurred while in the air In these men the blood pressure was higher on returning to the ground and remained so for several hours afterwards

These findings are attributed to the fact that the moderate excitement attending the anticipation of flight, combined with the naturally increased mental and nervous activity, caused the raise in blood pressure On finishing the flight the immediate nervous relaxation is shown by the drop in pressure The differences in the readings occurring before and after flight were more marked in the newer fliers when first placed under instruction, showing their increased nervous tension at that time The older and more experienced aviators showed scarcely any variations in pressure readings before and after flight and their general average was lower than the newer men The records showed no fluctuation of sufficient degree to be suggestive of anything pathological, merely accentuating the fact of the increased nervous strain to which the aviator is at all times subjected, and showing the gradual adaptation of the individual to this strain

Occasionally men complained of feeling stale tired and not up to the mark. This was ordinarily due to late hours need of a vacation, or lack of stamina on the part of the individual Irritability on the part of some of the instructors was quite marked at times Their work is unquestionably very trying and their number of hours in the air greater than the others.

EFFECT OF ALTITUDE FLIGHTS

Regarding altitudes and the physical effect on the flier, it might be noted here that the mean atmospheric pressure at sea level will balance a column of mercury 30 inches high and that in ascending there is a direct fall in pressure of about one inch in mercury to every thousand feet ascended The relative proportion of the constituent gases of the atmosphere remains the same with the exception of the watery vapors, which are confined to the lower levels. As the aviator ascends the tension of the gases in the bodily fluids balances that of the surrounding air Obviously the quantity of oxygen per cubic foot of air becomes progressively less as the pressure decreases and there is a drop in the arterial blood pressure of the flier

The latter factor is, in a healthy adult, slight and of minimum importance up to 1,500 feet, above this altitude the blood pressure drops more rapidly In older men with some hardening of the arteries, there is a much more decided drop in pressure, which change is evidenced by slight headache, dizziness and ringing in the ears. This fact may be noted any day in crossing the mountains in a railway train, if the portly florid man is questioned he will acknowledge these symptoms which are largely due to lack of elasticity of the arteries and consequently inability on the part of the arteries to contract and establish rapid equilibrium between the arterial pressure and the lowered atmospheric pressure

As has been previously stated the watery vapors are confined to the lower strata and as these are instrumental in retaining the heat of the sun's rays the atmosphere becomes cooler as one ascends. It will thus be seen that in making altitude flights three main factors must be considered; first, there is less oxygen to breathe, second, the arterial blood pressure is less, and last, there is a decided drop in temperature Some very interesting and valuable data has been gathered at various times both in this country and abroad in regard to the effects of altitudes on the individual, these experiments have been carried out on the peaks of high mountains It has in the first place been shown that among mountain climbers much more energy is expended by the untrained than by the trained climber, further, that men living at high altitudes develop more iron and red blood cells in the body This variation has been shown to be from approximately 5 million red blood cells per cubic millimeter of blood, at sea level, to 8 million at 14 000 feet The hemoglobin, the iron constituent of the blood cell whose function is to carry the oxygen from the lungs to the body cells, is increased from 20 to 30 per cent.

SCARCITY OF OXYGEN MAY CAUSE SICKNESS

The reason for this can readily be seen, the amount of oxygen per cubic foot of air is much less at high altitudes, the bodily oxygen demand remains constant, therefore any sudden muscular activity would bring the margin of oxygen safely down to the danger zone In consequence nature compensates by giving the blood more oxygen carrying and storing elements so that in case of any excessive exertion the body would have an adequate supply of this very necessary gas Altitudes have a tendency to increase the chest capacity, in this way increasing the oxygen intake

Mountain sickness, a malady which is directly attributable to the scarcity of oxygen at the higher levels, occurs in Europe as low as 9,800 feet, in the United States as a rule at considerably higher points The symptoms of this disease are a heavy oppressed feeling in the chest, difficult breathing, with nausea and vomiting There is also mental depression accompanied by a blue congested appearance of the face These symptoms are unquestionably accentuated and brought on at lower levels by the mountain climber, owing to the excessive physical effort in making the ascent Sitting quietly in the body of an airplane we should not expect such severe symptoms, nor any difficulty at all at such low altitudes.

I have heard men complain of slight dizziness, and headache when flying at altitudes of between 12 000 and 16 000 feet. These symptoms were dispelled by inhaling deeply Some men who have flown at high altitudes constantly over a long period of time, have developed a very definite susceptibility to the effect of altitudes. One of the most pronounced cases of this is that of Lieutenant Cowdin, an American in the French Flying Corps. Mr Cowdin has won the Croix de Guerre, the Medaille Militaire, the Legion of Honor, and the War Cross. He has brought down 17 of the enemies' machines, but at the present time is unable to fly at an altitude of over 3,000 feet without experiencing most annoying palpitation of the heart, and difficult breathing. The more severe symptoms of altitude sickness are immediately relieved by inhaling a few whiffs of oxygen, or administering some cardiac stimulant

The direct causative factor of this condition seems to be a definite weakening of the heart muscle owing to an inadequate supply of oxygen this being supplied the heart immediately resumes its normal functioning This all tends to emphasize the value of training and the

need of excellent physical form for the aviator. It is suggested that men who are going out after altitude records should live in the higher mountain regions for a time so that the body will be in the best possible condition to meet the demands of the occasion. This not being practicable a small oxygen tank with an inhaler may be taken along. This procedure corresponds to the necessary carburetor adjustment which is accorded the airplane engine on these occasions.

PHYSIOLOGICAL EFFECT OF SMASH UPS

Two distinct phenomena stand out vividly in my mind in connection with men who have been subjected to a smash of any severity. These are, first the immediate effects, and second, the more remote after-effects. I have seen men pulled out of wrecked machines after a 50 foot fall or a bad side slip, suffering from extreme shock, as evidenced by weak pulse, cold skin and pallor with either an active delirium or a stupor. This is much akin to the condition known as shell shock so many cases of which have been reported in the present war in which a shell bursts near but does not hit the man. These men may recover and come back and fly as well as ever; on the other hand I have known men who were only moderately shocked at the time of the accident but who later developed vague nervous symptoms which persisted for months and incapacitated them for work of any kind. Some of these men are forever afterward machine shy. I remember one aviator who had a slight mishap, on landing, the machine was turned over, but no one was hurt. For a long time afterwards, this man consistently over-controlled and spoiled all his landings.

HYPNOTIC EFFECT CAUSES ACCIDENTS

Another rather interesting condition of less frequent occurrence is that in which the flier apparently experienced a lapse or a period during which he remembers nothing and is unconscious of everything which has occurred. A few men have acknowledged to me that they have had such an experience. The most glaring of these lapses occurred to Herbert Latham who at the time was flying an Antoinette monoplane on Domluiens field in 1911. Latham came down on top of the grand stand and smashed his machine. He explained the affair by stating that at his last remembrance of anything he was flying level at an altitude of some 500 feet, the next thing he knew he was on top of the grand stand.

The general opinion seems to be that the monotonous drum of the propeller combined with the entire removal from external stimulus has a hypnotic effect and that this effect is very much increased if the aviator looks steadily at the propeller. In other words he should keep interested in the passing show. Many accidents in which the aviator has lost his life, and which are of such a nature as to be entirely inexplicable may be attributed to this cause. One of the main attributes of the stabilizer with its automatic control as demonstrated by Mr Maxi in his recent invention will undoubtedly tend to prevent accidents of this nature. It has been repeatedly demonstrated that a land machine will float for a time at least if unfortunate enough to land in the water. The sad death of Lieutenant Gerstner in 1914 who endeavored to swim ashore after his machine had gone into the ocean, suggests the advisability of staying with the plane. His companion was saved after being kept afloat for several hours by holding on to the landing wings.

I have had the pleasure of knowing many fliers both among the civilian and the military aviators and I have tried to pick a type, a man whose entire physical and mental make up should enable him to perfect himself in the art of flying. My conclusions are that the type does not exist. I believe that the early training of athletics is invaluable as a preliminary for flying. Athletics give a man instinct perception, quick judgment, with a rapid and facile coordination of the physical, all of which are very essential assets in the flying game.

Many of these intrepid pioneers of the air have lost their lives in this most hazardous but most fascinating of all sports. These losses should not be in vain; the cause of each fatality should be carefully determined so that the mistakes will not be repeated. The American is a composite and should lead in aviation. In him is combined the daring of the French with the ultra conservatism of the English and German and there are certainly times when both of these factors are needed.

British Airplane Testing Methods

A general account of some of the methods of testing the performance of airplanes as practised by the testing squadron of the Royal Flying Corps was given recently in England by Capt. H. T. Tizard before the Aeronautical Society.

He stated that so far as England is concerned, the general principles of the scientific testing of airplanes were first laid down at the royal aircraft factory. The methods of reduction adopted by the flying corps were based to a considerable extent on those of the R. A. F., with modifications jointly agreed upon; they have been still further modified since, and recently a joint discussion of the points at issue has led to the naval and military tests being coordinated, so that all official tests are now reduced to the same standard.

In order to reduce the results of a climbing test to standard atmosphere (i. e., the density of dry air at 760 mm. pressure and a temperature of 16 deg. Cent.) observations are required at intervals of the time from the start and of the height reached at those intervals. Here the difficulty arises that there is no instrument which records height with accuracy. The aneroid has faults partly unavoidable and partly due to those who first laid down the conditions of its manufacture. As now graduated it will give the correct height only if the atmosphere has a uniform temperature of 50 deg. Fahr. (10 deg. Cent.) from the ground upward.

Aneroid Observations

This temperature is much too high, and only on the hottest days in summer, and even then very rarely, will the average temperature between the ground and 20,800 ft. be as high as 50 deg. Fahr. In winter or cold days the reading may be 2,000 ft. too high at 16,000 ft., the aneroid showing 16,000 ft. when the real height is only 14,000 ft. Hence a temperature correction must be applied and on account of its magnitude it is important that observations of temperature should be made during every test. For this purpose a special thermometer is attached to a strut of the machine well away from the body and clear of any warm air coming from the engine. If the temperature is noted at the same time as the aneroid reading, both the atmospheric pressure and temperature at the point are known, and the density can be calculated or read off from curves drawn for the purpose.

The observations necessary (after noting the gross airplane weight and the net or useful weight carried) are therefore (1) aneroid height every 1000 ft., (2) time from the start of the climb, and (3) temperature, with (4) air speed and (5) engine revolutions at frequent intervals. The observed times are then plotted on squared paper against the aneroid heights, and from the curve drawn through them the rate of climb at any part can be obtained (also in aneroid feet) by measuring the tangent to the curve at the point. This is done for every 1000 ft. by aneroid and the true rate of climb is then obtained by multiplying the aneroid rate by the correction factor corresponding to the observed temperature. The time rates are then plotted afresh against standard heights, and the curve gives the rates of climb corresponding to the standard heights of 1,000 ft., 2000 ft., 3000 ft., etc.

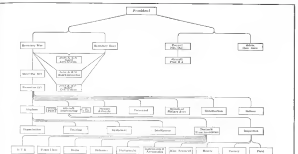
At least two climbing tests, and if time permits three or more are made of every new machine up to 16000 ft. or more by aneroid. The final results given are the official tests and represent as closely as possible the performance on a standard day with temperature effects, up and down currents, and other errors eliminated.

After reaching 16,000 ft. or whatever it is the flyer's next duty is to measure the speed flying level by air speed indicator at regular intervals of height (generally 2000 ft.) from the highest point downwards. The air speed indicator reads too low at great heights and its readings must be corrected by dividing by the square root of the density of the air. Even the corrected speeds will be true only if there are no disturbances due to the pressure head being in close proximity to struts or wings. Hence it is always necessary to calibrate the air speed meter and the only way of doing this is to measure the real air speed by actual timed observations from the ground. One method is to use two camera obscuras, one of which points vertically upwards and the other is set up sloping towards the vertical one. At one important training center the cameras are a mile apart. But when a machine has to be tried quickly and low clouds or other causes prevent the camera test from being carried out, it becomes necessary to rely on measurement of speeds near the ground, the airplane being flown about ten feet off the ground and timed over a measured run by two observers, one at each end of the course.

U. S. Navy Aviators in France

The Navy Department has announced that the first regular American fighting force on French soil consists of naval aviators who are to cooperate with the French Navy in meeting the submarine peril off the French coast and also to aid the American aviation section on the Western battle front.

The aviators include Lieutenant Grattan C. Dichman and Lieutenant Kenneth Whiting and Junior Lieutenants Godfrey de C. Chevalier and Virgil C. Griffin. Many of the others already have made their mark in the United States navy aviation service.



ORGANIZATION CHART
AIR SERVICE, U. S. ARMY.
June 2, 1917

Organizing Our Air Service

The above chart gives for the first time the organization and responsibility of our air service. It shows the channels through which the different committees, boards, and departments work and clears up for the aeronautical public a confusion which was the natural outcome of the quick expansion at the capital.

The National Advisory Committee for Aeronautics has issued a statement which makes clear its authorization, functions and financial support. In order to make plain its position the following statement to be followed by others by other boards is given:

"The National Advisory Committee for Aeronautics was authorized by Act of Congress approved March 3, 1917. The members were appointed by the President and include representatives of the War and Navy Departments, also the Departments of the Treasury, Agriculture and Commerce, and the Smithsonian Institution. In other words all of the departments interested in questions coming before the Committee, with the exception of the Post Office Department, which is interested in the organizing of the best machines for aerial mail service. Four technical members were appointed from without the Government service.

The Advisory Committee under appropriation by Congress began its work at once, with a view to first organizing the aeronautic industry into an association; second, clearing up the patent situation in relation to aeronautics, and third getting the industry into line to provide for quantity production of aircraft.

All of these results were brought about and on March 28, 1917, a communication was addressed to the Secretary of War and the Secretary of the Navy, and a copy transmitted to the Council of National Defense, recommending a continuing program for the production of aircraft.

On April [illegible], 1917, the Advisory Committee recommended to the Council of National Defense that an Aircraft Production Board be appointed to take over the consideration of the various questions arising in connection with the production of aircraft and the training of aviators both for governmental and civil purposes.

Both of the above recommendations were approved and an Aircraft Production Board was appointed with Mr. Howard E. Coffin as chairman.

On November [illegible], 1916, the Advisory Committee recommended to the Secretary of Agriculture that a systematic survey of the atmosphere be undertaken by the Weather Bureau. This was approved by the Secretary of Agriculture, an estimate was submitted and Congress has made an appropriation of $[illegible] to begin the work.

The Advisory Committee is now giving attention to the problems connected with the development of improved designs of aircraft, including examination of new inventions, and various lines of research work pertaining to the scientific and other problems incident to the development of aeronautics, and the question of insurance for aviators. Its function is quite different from that of the Aircraft Production Board and it is an entirely independent organization reporting directly to the Congress through the President. The authority for all proposals, specifications, and contracts for aircraft to be furnished to the Government rests with the War Department in the case of aircraft for the Army and with the Navy Department in the case of aircraft for the Navy.

The problems of the question of training of aviators which includes the purchase of grounds, the erection of buildings, methods of training, etc., all come within the jurisdiction of the War and Navy Departments, respectively. Neither the Council of National Defense nor the National Advisory Committee for Aeronautics nor any governmental board or committee has authority in the matter as far as the Government is concerned. The Government may contract with private organizations for the training of aviators if it desires to do so.

RULES AND REGULATIONS FOR THE CONDUCT OF THE WORK OF THE NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

Approved by the President of the United States June 14, 1917, in accordance with the provisions of an Act of Congress (Naval Appropriation Act, Public No. 271, 63d Congress) approved March 3, 1915.

RULES

The Committee may exercise all the functions authorized in the Act establishing an Advisory Committee for Aeronautics.

The Committee, under regulations to be established and fees to be fixed, shall exercise its functions for the military and civil departments of the Government of the United States, and also for any individual, firm, association, or corporation within the United States, provided, however, that such department, individual, firm, association, or corporation shall defray the actual cost involved.

No funds shall be expended for the development of inventions or for experimenting with inventions for the benefit of individuals or corporations.

REGULATIONS FOR CONDUCT OF COMMITTEE

Meetings

The annual meeting of the Advisory Committee shall be held in the City of Washington, in the District of Columbia, on the Thursday after the third Monday in October of each year. A semi-annual meeting of the Advisory Committee shall be held on the Thursday after the third Monday in April of each year at the same place.

Special meetings of the Advisory Committee may be called by the Executive Committee by notice served personally upon or by mail or telegraph to the usual address of each member at least five days prior to the meeting.

Special meetings shall, moreover, be called in the same manner by the Chairman upon the written request of five members of the Advisory Committee.

OFFICERS

The officers of the Advisory Committee shall be a Chairman and a Secretary, who shall be elected by the Committee by ballot to serve for one year.

The Chairman shall preside at all meetings of the Committee and shall have the usual powers of a presiding officer.

The Secretary shall issue notices of meetings of the Committee, record its transactions, and conduct the correspondence relating to the Committee and to the duties of his office.

COMMITTEES

There shall be an Executive Committee which shall consist of seven members to be elected by the Advisory Committee by ballot from its membership for one year. Any member elected to fill a vacancy shall serve for the remainder of his predecessor's term. The Executive Committee shall elect its Chairman.

The Aircraft Industry Is Prepared

By Benjamin L. Williams

Secretary Aircraft Manufacturers' Association

The American aircraft industry is in a position to meet the most liberal developments that can occur. Our factories are equipped and tooled up and employ about ten thousand men who are capable of turning out any quantity of at least five different types of airplanes and sea planes, to meet any requirements that foreign experience has indicated during the past two years as being desirable. Many factories are now working on the relatively small orders that have been placed with them by this Government, and are anxiously awaiting the word to expand to a greater degree.

Earl Kitchener in the early part of the war, placed with the British aircraft constructors orders that were far beyond their ability to produce, and as a consequence, the industry had enough work ahead to enable it to make a decided advance.

In America the industry has orders that have been placed with them well in hand, and type for type can equal the foreign built machines, although the constructors abroad have had the advantage of three years' intensive development, backed up by an exceedingly liberal encouragement from the Government.

The American industry, given the same amount of money and the same degree of encouragement, has the ability to overshadow even this great achievement, far beyond the highest expectations.

American ingenuity and commercial enterprise along practical lines is bound to win out, and with the assurance of continued orders for a definite period the individual manufacturers who now are representative of a well established industry will give a most excellent account of themselves.

It is, however essential that to enable the industry to map out a definite plan of action to meet the new conditions, the fullest possible support be given by all who are directly concerned.

Meeting of Aircraft Manufacturers' Association, Held June 13, 1917

The meeting was called to order by President Russel. The following members were in attendance:

Mr Upperci Aeromarine Plane & Motor Corp
Mr Bassett Burgess Company
Mr Tarbox, Curtiss Aeroplane & Motor Corp
Mr Flint L W F Engineering Co
Mr Mingle Standard Aero Corp
Mr Foss Sturtevant Aeroplane Co.
Mr Foss, B F Sturtevant Company
Mr Morse Thomas Morse Aircraft Corp
Mr Williams Secy Aircraft Mfrs. Assoc

An all day session was held the morning being devoted to the reports of the various committees and the afternoon session to the regular business of the association.

The Patents Committee had before it many subjects relating to advanced ideas in the aeronautical art and some safety devices were submitted. From these devices a selection will be made as best suited to immediate requirements and the development work essential thereto put under way.

The Standardization Committee

The committee was named as the result of long and carefully considered deliberation and the A. M. A. has now determined to undertake the work of establishing its own standards for the aircraft industry in cooperation with the S. A. E. The entire technical talent of the manufacturers has been placed at the disposal of the Standardization Committee and it is the feeling of the A. M. A. that the ability of these men directed toward a common end will be productive of more successful results than could be obtained through the S. A. E. alone.

The S. A. E. will be invited to have representation on the A. M. A. Committee and appreciation is expressed for the good work done thus far for the aeronautical industry by their committees. It is proposed to proceed at once with the work on standardization of the six [illegible] subjects and the construction work will follow as rapidly as is essential to the expedition of the manufacture of aircraft in quantities.

These items are as follows:

1 Turnbuckles.
2 Eyebolts
3 Shackles
4 Bolts & nuts
5 Propeller hubs.
6 Wire & cable ends.
7 Special light pipe fittings.
8 Flange & filler caps for gas & oil tanks
9 Wheels & hubs.
10 Control pulleys
11 Control arms.
12. Location of controls in cockpits
13 Seats
14 Strut sockets.
15 Strut ends
16 Motor supports (on crank case)

Membership Committee

Orville Wright was elected an honorary member in recognition of his work as a pioneer in the aeronautical art.

Elmil Scott Co was elected a manufacturing member with H. T. Whitaker as their representative. Communications were received from the Dayton-Wright Co. and the Wright Martin Co.

The materials committee reported that the industry already had on hand at the factories 4 000 000 feet of air dried spruce suitable for airplane construction and 300 000 yards of Irish linen for wing and body covering this being sufficient to produce 2 500 airplanes immediately.

The committee also reported that through the efforts of the Association difficulties had been overcome in the transportation of materials and the delivery of finished products from the allied trades. Through the association office an industrial director had been established, covering a field supplying raw materials and finished products to the aircraft industry.

The publicity committee reported that they are maintaining a press bureau and are acting on instructions from the Board of Directors. It will be the duty of the committee to correct all wrong impressions that appear in public print relating to the manufacture of aircraft. Up to the present time there has been no source of authoritative information such as the Manufacturers Association now could supply. With the information now at hand the Association is in a position to place before the public the true facts relating to the ability of the aircraft industry to meet the requirements of the Government.

Advisory Committee

A letter was received and read from Mr. Howard E. Coffin regarding the Aircraft Industry, in which he said in part:

"I desire to state there is no intention upon the part of the Aircraft Production Board to attempt any concentration of the aircraft industry in Detroit. And I wish you would dispel at once for all any feeling that there is other than the fairest and most impartial of attitudes which actuates the Aircraft Production Board in its plans for providing aircraft for the military service.

"It is the desire of the Board that the closest possible relations be maintained between it and the Aircraft Manufacturers Association. We have a tremendous task on our hands, and it is going to require the most careful planning and co-operation to accomplish the proposed programme."

A canvass of the members indicated that they only awaited the word to proceed in a continued program that would enable it to expand to a degree sufficient to enable the industry to meet the immediate requirements for airplanes and at the same time further expand to meet the highest estimates that could be made based on the war time experience of the Allies.

The committee has been in consultation with the authorities at Washington and made frank statements as to their ability to produce airplanes in quantity. The time has now arrived for prompt action and the association concurs in the plans as laid down by the individual manufacturers by the Aircraft Production Board.

Production of Training Machines

The afternoon session was devoted to a free discussion of the ability of the manufacturers to produce the training type of machines in quantity. The result of this was that it was found that while it was the sense of the meeting that the manufacturers preferred to make their own type of machine in the greatest possible quantities and at the same time carry along the development of the Allies training type of airplane it was also agreed that upon the completion of their work as of January 1st they would be well started on a fully developed program for this one type of aircraft in view of the immediate needs of the Government for more of the training type of machine the manufacturers say that they will sweep aside for the present their equipment suitable for regular production and concentrate on the Allies training type of machine and follow later with their own types if desired.

Society of British Aircraft Constructors

A communication was read from the Society of British Aircraft Constructors, in which they expressed a desire to have a close cooperation with the Aircraft Manufacturers' Association in America.

The British society is composed of the aircraft industry of England. They state that practically every British constructor of aircraft or aircraft engines is a member of this society. They expressed the belief that the future development of aviation would be greatly expedited by the close cooperation of the British and American industries. Through their respective organizations.

This affiliation is perhaps one of the most important events that has occurred in the development of the aircraft industry. It brings to the industry through their respective associations first hand information free from personal bias of aircraft and statements of facts, based on actual observation, developed from experience in the field and viewed from a manufacturer's standpoint.

It will be remembered at this point, that the aircraft industry in England at the beginning of the war was vastly inferior to the aircraft industry in America at the present time, that with three years' experience, encouraged by vast appropriations from the Government, and hastened in actual warfare the present output in finished planes is about eight hundred per week. The manufacturers engaged in this work have a capitalization of $375 000 000.

The industry in America has a capitalization of about $20 000,000 and based on a peace time equipment, we are able in a period of three months to turn out one-half as much as England.

CURTISS FACTORIES, FLY

THE CURT

OPLANE CO.

A.

ESTERN UNION CODE

CABLE ADDRESS "

THE Curtiss Aeroplane Co. has always been the dominating center of aviation in America. Its capacity has steadily grown until today it is the largest and best equipped aeroplane manufacturing corporation in the world, amply equipped with all facilities for building a large variety of types of aeroplanes, hydroaeroplanes, flying boats and aeronautical motors in *large quantities and for prompt delivery.*

AND TRAINING SCHOOLS

IN addition to the main plant and executive offices in Buffalo, N. Y., there are four other branch factories — three in Buffalo, N. Y., and one in Hammondsport, N. Y., as well as Training Schools, Hangars and Flying Fields at Buffalo, Hammondsport, N. Y., Newport News, Va., Miami, Fla., and San Diego, Cal.

The America Trans Oceanic Co., 280 Madison Avenue, New York City, New York Agents.

Summer Meeting of the S. A. E.

On June 26 the semi annual meeting of the Society of Automotive Engineers will be held at the Bureau of Standards, Washington. On account of the present national emergency, the meeting will be limited to one day. The usual business session will be held in the morning, when the Standards Committee will report and routine business will be transacted.

At one of the meetings President George W. Dunham will deliver an address showing what the Society has been doing in national affairs in the past and also what it hopes to accomplish for the nation in the future.

The afternoon will be devoted to a professional session at which will be presented papers of far reaching interest on airplane manufacture, motor truck operation under war conditions, the use of farm tractors in increasing the food supply of the nation, and the methods followed in the quantity production of submarine chasers.

In the evening an informal dinner will be held at the New Willard Hotel. The speakers who have already accepted invitations to address the members are Secretary of War Newton D. Baker, General George O. Squier, Chief Signal Officer of the United States Army, and Colonel Clarence R. Baker, chief of the Transportation Division of the Quartermaster Corps.

Meeting of Standards Committee

A meeting of the Standards Committee will be held at the Bureau of Standards on Monday morning, June 25. A number of the Divisions of the Committee, such as the Aeronautic Marine, Tractor and Truck divisions, are spending all their time on work connected with government activities. This meeting is open to all the members of the Society and it is expected that a number of reports will be presented of universal interest.

In the afternoon after the conclusion of the Standards Committee meeting arrangements are being made to show the members through the buildings of the Bureau of Standards. The Bureau is housed in an imposing group of buildings, situated about four miles from the center of Washington City. The extensive laboratories devoted to research work along physical and chemical lines will be of interest to every member. Plans are being made for special exhibitions for the benefit of the members, showing the various activities of the Bureau.

Papers at Professional Session

While only a comparatively small number of papers will be presented at the professional session, which will be held on the afternoon of Tuesday, June 26, every one of them will be of the most vital importance. The paper on aeronautics is to be given by Wing Commander J. W. Seddon, R. N. A. S. who is a member of the British Commission in this country. It is expected that his paper will deal with the practical effects of airplane manufacture and will include a great amount of information needed by manufacturers and engineers in this country. Commander Seddon has had much practical experience in operating airplanes on the Somme front.

Frank H. Russell on Automotive Committee of National Defense Council

Frank H. Russell, President of the Aircraft Manufacturers Association, has been appointed a member of the Automotive Committee of the Council of National Defense.

COL. WILLIAM MITCHELL, U. S. A.

Col. Mitchell Honored

According to a dispatch from Paris for efficiency and bravery, in the face of the enemy, Col. Mitchell, aviation attaché of the American military mission to France, has been cited in general orders. This is the first instance of its kind that has fallen to the lot of an American regular army officer since the outbreak of the war.

Col. Mitchell was sent to the front several weeks ago to study flying problems at first hand. It was during an infantry attack that he performed deeds of great valor, flying close to the ground in order to guide the movements of the attacking troops.

Col. Mitchell, who this month was made a Lieut.-Colonel for several years was in the General Staff of the United States Army and before being ordered to France on aviation duty by the Secretary of War was assisting General Squier to organize the Aviation Section of the Signal Corps.

G. C. Loening Returns

Grover C. Loening is back in this country from a trip to England, where he had an opportunity of inspecting many of the English flying fields, factories and naval stations.

The Army Schools

The nine Army schools estimated in the Army appropriation bill are as follows:

Mineola, L. I.	(Operating.)
Ashburn, Tex.	(Operating.)
San Diego, Calif.	(Operating.)
Mt. Clemens, Mich.	(Ordered and under construction.)
Fairfield, Ohio.	(Ordered and under construction.)
Rantoul, Ills.	(Ordered construction to begin at once.)
San Antonio, Texas.	(Under construction.)
So. Miss. Valley	(Under investigation.)

The ninth school has not yet been located, but the War Department contemplates its location to be in the Rocky Mountain region. Other schools will doubtless be established as exigencies require, and in addition to the training schools established on United States soil the Department has let contracts for the immediate establishment of a two squadron school in France, which will be built and equipped by American contractors. The site has been selected, and all construction material will be shipped from this country. Training at this school will be on French machines and under French Army instructors.

The 1st Aviation School Squadron is located at San Diego, the 2nd at Mineola, the 3rd and 4th at Ashburn, the 1st and 2nd Reserve Aviation Squadrons are at Mineola and Essington, Pa. respectively, while seven aero squadrons have been organized and are on duty as follows: 1st, at Columbus, N. M.; 2nd in the Philippines, 3rd, 4th and 5th at San Antonio, Texas; 6th at Honolulu, and 7th on the Canal Zone.

Squadron Notes

Six machines have been received by the 4th Aero Squadron at San Antonio. Infantry drill with and without arms is held five days a week, from 7-11 a. m. and 1-3 p. m.

A total of 434 flights of 239 hours and fifty minutes in the air were made during the week by the 1st Aviation School Squadron at San Diego. The officers received instruction in aero engines, motor cycles, construction and repair of airplanes and radio telegraphy. The enlisted men received practical work on engines together with military instruction.

Some forty flights were made during the week by the 1st Aero Squadron at Columbus, N. M. with a total of nine hours and nineteen minutes in the air. Six machines have been received. Captain Mills left for duty at the Massachusetts Institute of Technology, one of the ground schools for pilots.

Marine Corps Aviation Station

The Marine Corps is establishing an advance base flying school on League Island near Philadelphia. The field, hangar and equipment formerly used by the Aero School of Pennsylvania, have been turned over to the Corps, and Capt. A. A. Cunningham is in charge.

Winston Churchill Heads British Air Board

It is announced from London that Col. Winston Spencer Churchill has accepted the Chairmanship of the British Air Board, in succession to Viscount Cowdray.

Winston Churchill was First Lord of the Admiralty when the war began. He was severely criticized for certain naval measures he was said to have fathered, and for losses that had attended the British fleet—the sinking of the Aboukir, Cressy, and Hogue by a German submarine in the North Sea, the loss of Sir Christopher Cradock's squadron off Chile, and the Gallipoli fiasco—and when the Asquith Ministry was reconstructed in May, 1915, and made a coalition Cabinet, he was relegated to the post of Chancellor of Lancaster which he filled without salary until the following November, when he resigned and went to the front with the rank of Colonel. Since then he has written much on the war and as a member of Parliament from Dundee has made several notable speeches in the House of Commons, principally in defense of his policy while First Lord.

He is the son of the late Right Hon. Lord Randolph Churchill and Lady Randolph Churchill (née Jerome of New York.) Before the war he was looked upon as England's rising man.

Death of Capt. Ball

The British War Office has received confirmation that Captain Albert Ball one of Great Britain's most noted aviators, was killed in action some time ago. Captain Ball had been missing since May 7.

The aviator had made a brilliant record, his score of enemy airplanes shot down up to the early part of the year having been twenty nine. He was only twenty-one years old.

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ROYAL FLYING CORPS FI MP BORDEN, CANADA

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The pictures of Camp Borden and its p
Corps, indicate the magnitude of the wh ced through the courtesy of the Royal Flying
Canada. one of several that have been established in

The lower picture shows the fifteen han
shows the officers' and cadets' quarters. Th ousing six airplanes. The upper picture
officers and enlisted men are shown n the side show the cadet aviators, while only
chines is also shown. A close view of one of the hangars and ma-

These pictures bring out clearly the la
sary to train even a few military aviators. mechanics and other camp personnel neces-

Recruiting for the Royal Flying Corp
who might be eligible can secure there n at 280 Broadway, New York, and those
are being recruited, it is interesting to red. While Canadians and English subjects
of the officers and men are Americans.

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Army and Navy Orders

Capt. Frank Page S.O.R.C. son of Walter Hines Page the American Ambassador to London has been ordered to active duty and assigned to the office of the Chief Signal Officer as manager of cadet training. He will visit the Canadian aviation school at Camp Borden to investigate the system in vogue there. Other recent details to General Squier's office include Capt. William Larned S. O. R. C. who for several years was the national tennis champion and Capt. R. B. Owens S. O. R. C. until recently secretary of the Franklin Institute. Captain Larned has been assigned to the examining board which passes upon candidates for commission in the aviation section.

Capt. Ralph L. Taylor S. O. R. C. to active duty at Mineola Long Island N. Y.

First Lieut. Warren C. Woodward S. O. R. C., from Memphis to Fort Sam Houston, Texas, to duty with the 3d Aero Squadron.

Capt. Walter R. Taylor S. O. R. C. to active duty at headquarters Southern Department.

Columbus, Ohio, for duty at Ohio State University.

Major Alfred T. Clifton, S. C., to Fort Sam Houston, Texas, for duty as signal officer of Southern Department.

Capt. Leo G. Heffernan 3d Aero Squadron S. C. to Aviation School San Antonio for duty.

Capt. John N. Reynolds, Av. Sec. S. C. to Fort Sam Houston Texas, for duty.

Capt. Paul L. Ferron, junior military aviator S. C. detailed as aeronautical officer of the Southern Department, vice Major Townsend F. Dodd S. C. relieved.

First Lieut. Howard F. Culver Av. Sec. S. O. R. C., to active duty at Fort Sam Houston, Texas.

Capt. J. L. Dunsworth and 1st Lieut. Patrick Frissell Av. Sec. S. C. to Fort Sam Houston for duty.

First Lieut. W. N. Fast Av. Sec. S. C. to Columbus N. M., duty 1st Aero Squadron.

Major Henry B. Hersey Av. Sec. S. O. R. C. to active duty at Balloon School Fort Omaha.

Officers of Aviation Section S. O. R. C. to active duty, report in person to commanding general Southern Department for assignment: Capt. Max C. Fleischmann, Capt. Pierre DeL. Boal; 1st Lieuts. Daniel P. Morse, Stephen H. Noyes and Daniel Buckley.

First Lieuts. Seth Low and Cord Meyer S. O. R. C., to Governors Island, N. Y., for duty.

First Lieuts. H. M. Gallop, W. G. Shauffler, W. V. Barnaby and W. C. Rolph, S. O. R. C., to Columbus, N. M. for duty with 1st Aero Squadron.

First Lieut. Daniel Buckley, Av. Sec. S. O. R. C. to active duty, Fort Sam Houston with an aero squadron.

Three Members of the British [illegible] Left to Right: Lieut. de la Grange of the [illegible] Major [illegible] W. [illegible] of the British Flying Corps, and Major Tulasne of the French Flying Corps

First Lieut. Roderick H. Jones, S. O. R. C. to active duty at Aviation School, Mineola Long Island, N. Y.

First Lieut. Clarke Thomson, S. O. R. C., to active duty at Fort Sam Houston Texas, with 3d Aero Squadron.

First Lieut. Victor W. Page, S. O. R. C. to active duty at Mineola Long Island, N. Y.

Each of the following officers will report to board at Aviation School, San Diego Cal., for examination for rating as junior military aviators: Capt. Guy L. Gearhart C. A. C.; 1st Lieuts. Thurman H. Bane 8th Field Art., Claude K. Rhinehardt 17th Cav., Norman W. Peek Inf., D. O. L.; Thorne Duel, Jr. Cav., D. O. L.; John C. Prince, Cav., D. O. L.; Harvery B. S. Barwell, 13th Cav., Warren P. Jernigan, Cav.; John E. Rossell Inf.; Norman J. Boots, 10th Cav., and William B. Peebles, Cav.

Capt. George E. Stratemeyer, S. C. to

North Island Site.

A bill authorizing the President to take possession of, on behalf of the United States, and to use as sites for permanent aviation station for the Army and Navy, the whole of North Island, in the harbor of San Diego, Cal., was introduced in the House on June 6 by Chairman Dent of the Committee of Military Affairs. The property will be appraised and the value adjudged by a board of real estate experts.

Navy Aviation Stations

Civil Engr. F. H. Cooke, U. S. N. has been detailed to take charge of the construction of buildings at seven aviation stations along the coast. It is estimated that $100 000 will be expended at each of the sites, which are as follows: Montauk Point L. I., Rockaway Beach, L. I.; Cape May, N. J.; Philadelphia, Pa. (Navy Yard); Old Point Comfort Va.; Key West, Fla., and near Colon, C. Z.

Fort Sam Houston

Instructions have been received at the headquarters of the Southern Department at Fort Sam Houston, Texas, to establish at the aviation camp there twenty seven aero squadrons. These are to be of a strength of 150 men each, giving a strength to the camp of 4 050 men. There are to be twenty four airplanes to each squadron, making a total of 648 machines for the San Antonio Aviation Camp. There are twelve machines in use in each squadron and twelve held in reserve. 1 500 recruits have already been enlisted for the camp and these are being sent from all parts of the country. Capt. S. W. Cook Cav. U. S. A. is the commanding officer of the aviation camp.

New Dirigible Built for Navy Flies More Than 400 Miles

The Navy Department authorizes the following:

Reports have reached the Navy Department that the first of the sixteen non-rigid dirigibles being built for the Navy has made a successful flight of more than 400 miles. This dirigible left Chicago at midnight and arrived at Akron Ohio between four and five o'clock the next afternoon. As this was merely an experimental flight and not an official test, no attempt was made to attain high speed. The contract requires that these balloons make 40 miles an hour.

This is a new type of airship designed by the Navy Department and is on the order of the "blimps" the non-rigid dirigibles which England has been using with such success. The design was prepared by Naval Constructor J. C. Hunsaker of the Bureau of Construction and Repair under the direction of Admiral Taylor, chief of the bureau.

Sixteen Contracted For

Sixteen were contracted for some two months ago. The Goodyear Tire & Rubber Co. is building nine and the others are being built by The B. F. Goodrich Co., the Curtiss Aeroplane Co. and one by the Connecticut Aircraft Co. It is expected that they will hereafter be completed at the rate of one a week and that will be delivered by August.

The American "blimps" will form a part of the coast patrol and will be distributed along the coast as lookout to watch for the approach of enemy vessels. The English have found this type very effective in detecting submarines.

War of 1917 Pension Claim

Among the claims filed in the Bureau of Pensions on account of our present war is one by Susie A. Van Kirk, of Washington, D. C. She was the mother of Dean R. Van Kirk who was an ensign and attached to the Naval Battalion, National Guard of the District of Columbia. He died on May 1, 1917, at Pensacola, Fla.

On account of the death of a person in the aviation service the pension is double the amount of the ordinary pension under like circumstances.

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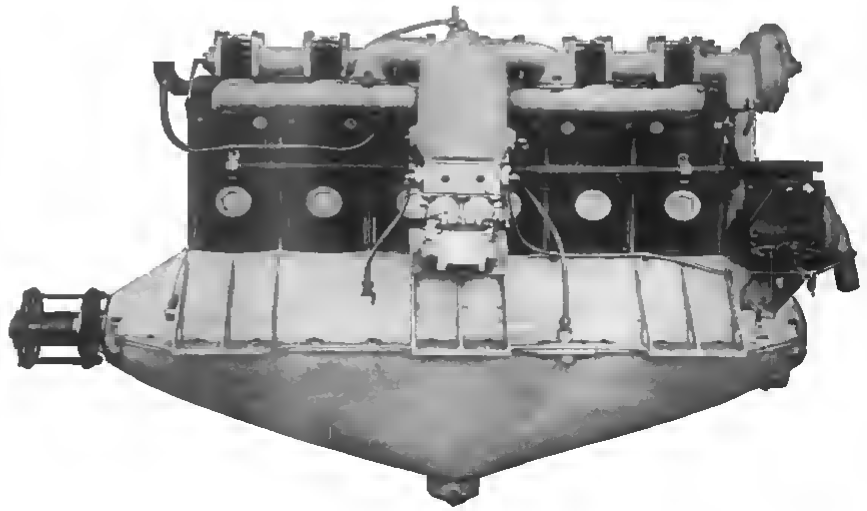

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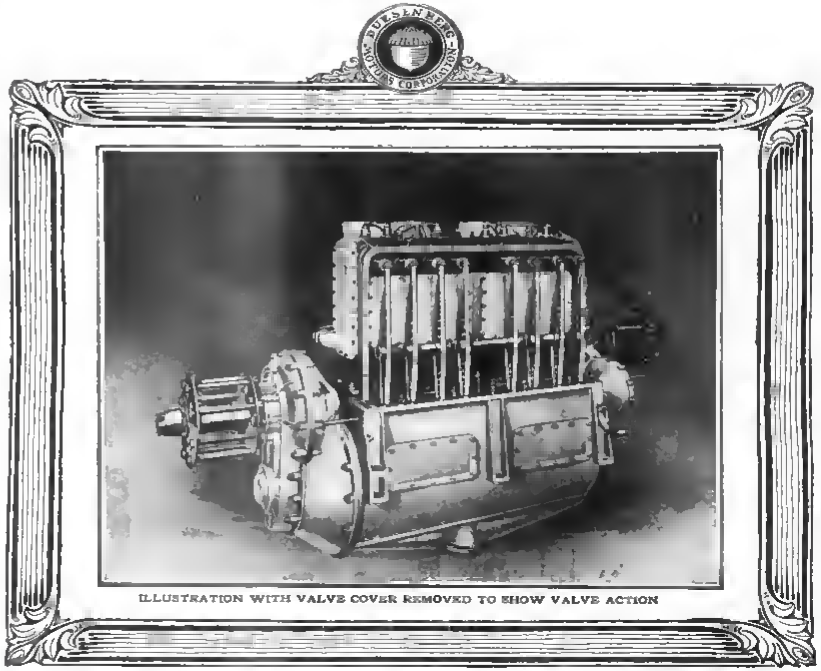

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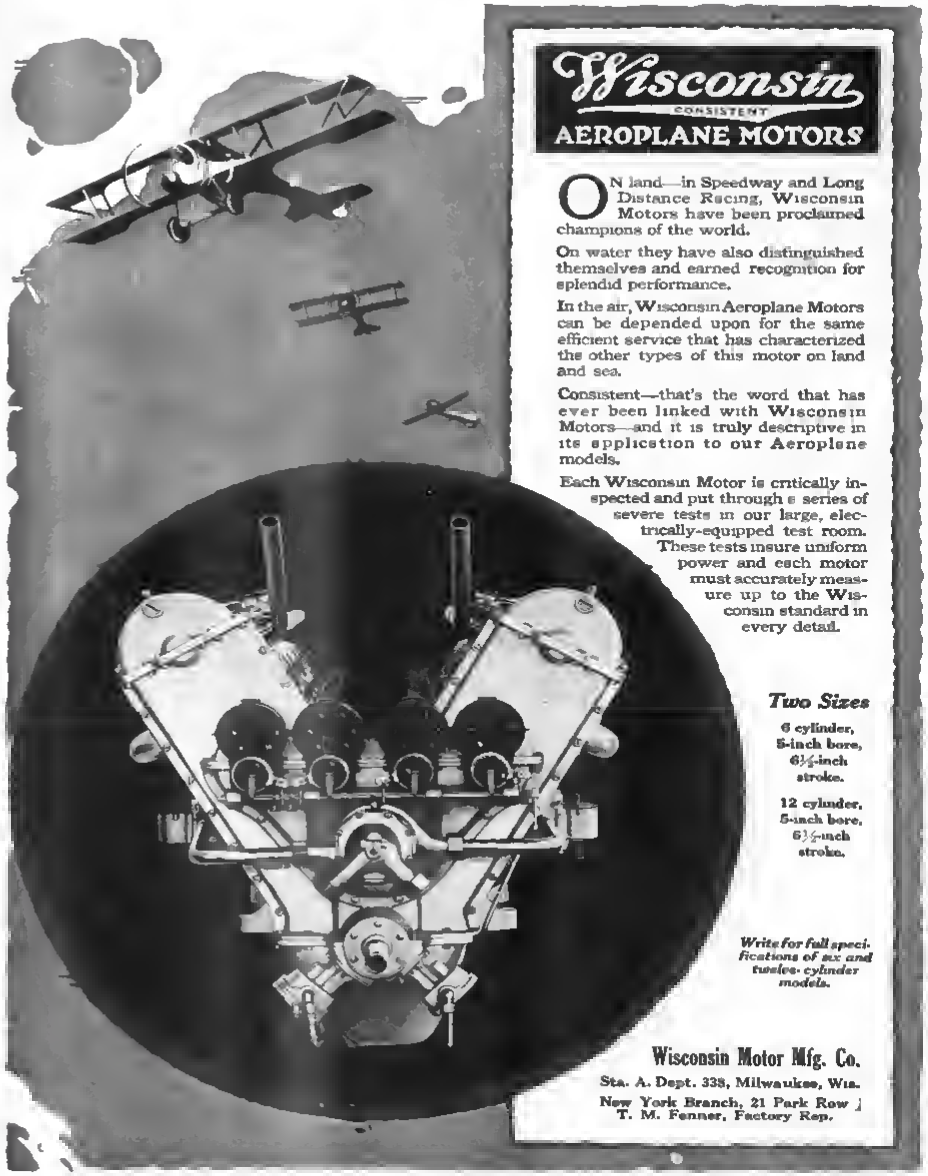

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